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REPORT

ON

STOCKTON RESERVOIR

DADE, POLK, AND CEDAR COUNTIES

MISSOURI

EPA REGION VII

WORKING PAPER NO. 549

WITH THE COOPERATION OF THE

MISSOURI DEPARTMENT OF NATURAL RESOURCES

AND THE

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FEBRUARY, 1977

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT ON STOCKTON RESERVOIR

DADE, POLK, AND CEDAR COUNTIES, MISSOURI

EPA REGION VII

by

National Eutrophication Survey

Water and Land Monitoring Branch
Monitoring Applications Laboratory
Environmental Monitoring & Support Laboratory
Las Vegas, Nevada

and

Eutruphication Survey Branch
Corvallis Environmental Research Laboratory
Corvallis, Oregon

Working Paper No. 549

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY

February, 1977

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by the U.S. Environmental Protection Agency and to augment plans implementation by the states.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Missouri Department of Natural Resources for professional involvement, to the Missouri National Guard for conducting the tributary sampling phase of the Survey, and to those Missouri wastewater treatment plant operators who provided effluent samples and flow data.

The staff of the Missouri Department of Natural Resources, James Wilson, Director; the Division of Environmental Quality, Ron Kerch, Director; and the Water Quality Program, James Odendahl, Director, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper series.

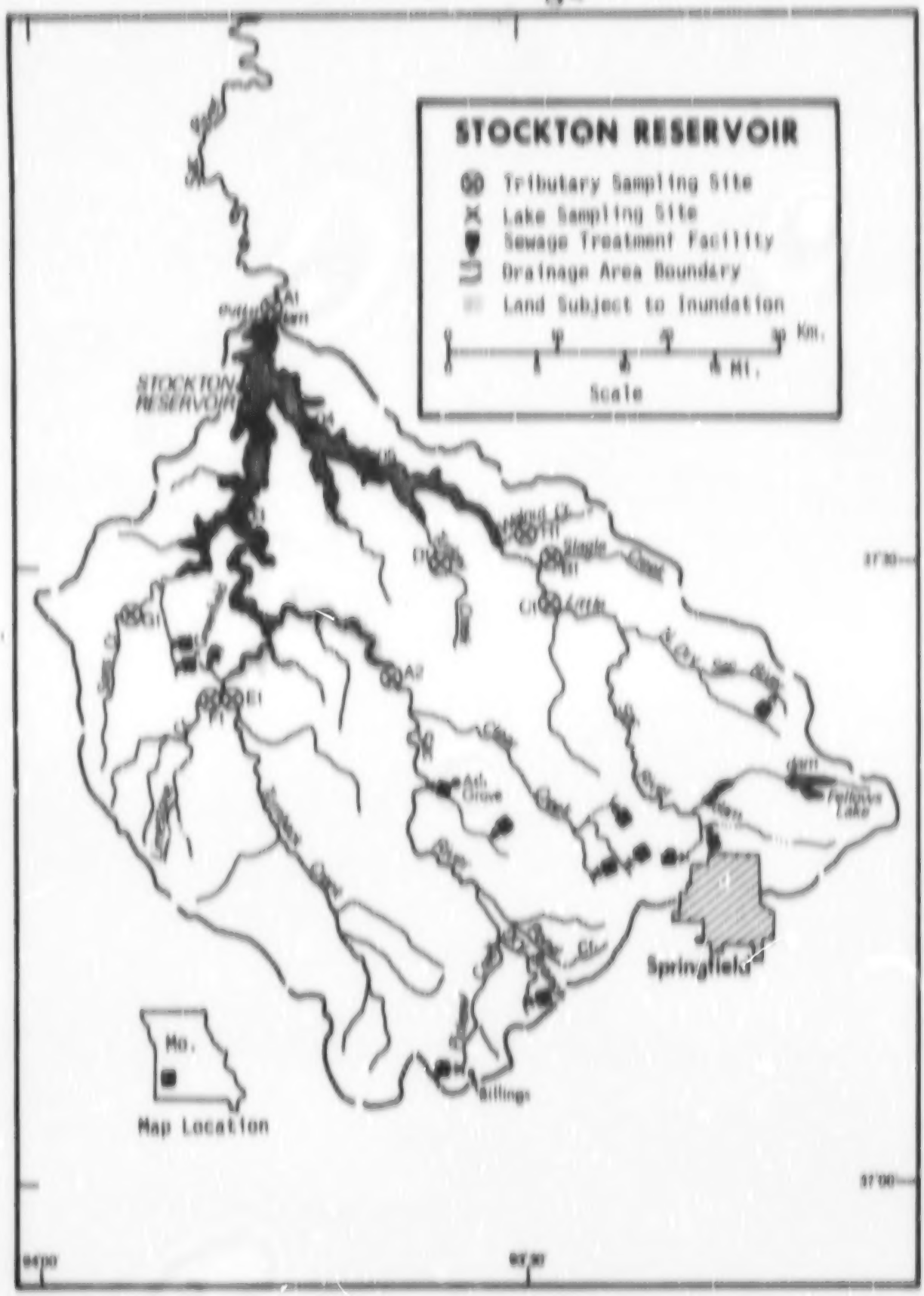
Major General Charles H. Kiefner, the Adjutant General of Missouri, and Project Officer Captain Donald L. Wellen, who directed the volunteer efforts of the Missouri National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MISSOURI

LAKE NAME	COUNTY
Clearwater Lake	Reynolds
Pomme de Terre Reservoir	Polk, Hickory
Stockton Reservoir	Dade, Polk, Cedar
Lake Taneycomo	Taney
Thomas Hill Reservoir	Macon, Randolph
Lake Wappapello	Wayne, Butler


STOCKTON RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Drainage Area Boundary
Land Subject to Inundation
Km.
Mi.
Scale
STOCKTON RESERVOIR
Springfield
Mo.
Map Location

REPORT ON STOCKTON RESERVOIR, MISSOURI

STORET NO. 2903

I. CONCLUSIONS

A. Trophic Condition:*

Based upon field observations and Survey data, Stockton Reservoir is considered early eutrophic. Chlorophyll a values ranged from a low of 1.3 µg/l in the summer to a high of 29.2 ug/l in the spring with a mean of 9.0 µg/l. low Secchi disc visibility (mean of 180 cm) and low potential for primary productivity as measured by algal assay control yield were reported. There were oxygen depletion and hydrogen sulfide production noted at Stations 03 and 01 during the summer sampling season and at Station 04 during the fall. Of the six Missouri lakes sampled in 1974, four had greater median total phosphorus levels, one had greater median inorganic nitrogen values, and three had greater median dissolved orthophosphorus levels than Stockton Reservoir. It should be noted that although phosphorus levels in the lake were similar throughout the seasons, the spring chlorophyll a values observed were an order of magnitude higher than summer values and approximately 4-5 times those observed in the fall. This same spring phenomenon can be observed in the algal counts for the similar centric diatom-based communities found in the lake all three sampling dates.

*See Appendix E.

Survey limnologists reported no problem conditions in the lake during the sampling year.

B. Nutrient Limiting Nutrient:

Algal assay results indicate that Stockton Reservoir was limited by available phosphorus levels. Spikes with phosphorus or nitrogen and phosphorus simultaneously resulted in increased assay yields. Addition of nitrogen alone did not stimulate a growth response. The ratios of available nitrogen to orthophosphorus (N/P) in sampled waters substantiate phosphorus limitation.

C. Nutrient Controllability:

1. Point sources -

Point sources were estimated to contribute 42.0% of the total phosphorus load to Stockton Reservoir during the sampling year. The Springfield Northwest wastewater treatment plant contributed 25.6% of the total load and the city of Ash Grove contributed 7.7%. The remaining 12 plants were estimated to contribute 8.7% of the phosphorus load. There are a number of small private facilities and four industrial plants (Kerr-McGee Chemical Corporation; Conco Quarries, Inc.; Greismer Stone Company; Advanced Circuiting - a Division of Litton Inc.) which are not included in the nutrient budgets for Stockton Reservoir (Missouri Department of Natural Resources, manuscript). It is not known at this time how much these unmeasured sources contributed to nutrient loadings in the reservoir.

The calculated phosphorus loading of 0.49 g $P/m^2/yr$ to Stockton Reservoir is twice the loading proposed by Vollenweider (1975) for an oligotrophic lake, and less than Vollenweider's eutrophic loading figure. However, spring chlorophyll a values in the lake (9.7 - 29.2 ug/l) as well as excessively high spring algal counts indicate a much higher biological response to existing nutrient levels than would typically be expected. In light of this demonstrated increase in spring lake productivity it would be desirable to substantially reduce phosphorus contributions from known point sources in order to improve lake water quality and decrease the likelihood of problem algal blooms or macrophyte growths in the reservoir.

2. Nonpoint sources -

The total phosphorus load from nonpoint sources accounted for 58.0% of the total load reaching Stockton Reservoir. Measured tributaries contributed 23.2%, while ungaged drainage areas were estimated to have contributed 31.2%.

The phosphorus export rates of the three gaged tributaries to Stockton Reservoir (range of 2 to 13 kg $P/km^2/yr$, mean of 7 $kg/km^2/yr$) were comparable to the rates of the gaged tributaries surveyed in nearby Pomme de Terre Reservoir[6] (see Section IV-D).

[6]Working Paper No. 548

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. Lake morphometric data were provided by the Missouri Clean Water Commission. Tributary flow data were provided by the Missouri District Office of the U.S. Geological Survey (USGS). Outlet drainage area includes the lake surface area. Mean hydraulic retention time was obtained by dividing the lake volume by the mean flow of the outlet. Precipitation values are estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No. 175. A table of metric/English conversions is included as Appendix A.

A. Lake Morphometry:

1. Surface area: 100.77 km^2.
2. Mean depth: 7.3 meters.
3. Maximum depth: =30.5 meters.
4. Volume: 735,621 x 10^6 m^3.
5. Mean hydraulic retention time: 386 days (1.06 yrs).

B. Tributary and Outlet:
(See Appendix 5 for flow data)

1. Tributaries -

Name	Drainage area(km^2)	Mean flow (m^3/sec)
A-2 Sac River	587.9	4.39
C-1 Little Sac River	606.1	4.64
E-1 Turnback Creek	525.8	3.88
Minor tributaries and immediate drainage -	1,183.8	9.74
Totals	2,903.6	22.65
2. Outlet - A-1 Sac River	3,004.4	21.97

C. Precipitation:

1. Year of sampling: 110.8 cm.
2. Mean annual: 99.8 cm.

III. LAKE WATER QUALITY SUMMARY

Stockton Reservoir was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from five stations on the lake and from a number of depths at each station (see map, page v). During each visit, depth-integrated samples were collected from each station for chlorophyll *a* analysis and phytoplankton identification and enumeration. During the first and last visits, 18.9-liter depth-integrated samples were composited for algal assays. Maximum depths sampled were 30.5 meters at Station 01, 24.4 meters at Station 02, 20.7 meters at Station 03, 22.9 meters at Station 04, and 16.8 meters at Station 05. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix C and are summarized in III-A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll *a* determinations are included in III-B. Results of the limiting nutrient study are presented in III-C.

[illegible]

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/08/74	1. Melosira	16,510
	2. Stephanodiscus	3,300
	3. Chroomonas	430
	4. Ankistrodesmus	387
	5. Cryptomonas	260
	Other genera	680
	Total	21,670
06/24/74	1. Fragilaria	599
	2. Melosira	436
	3. Chroomonas	381
	4. Cryptomonas	381
	5. Tetraedron	163
	Other genera	328
	Total	2,288
10/08/74	1. Melosira	879
	2. Dactylococcopsis	770
	3. Chroomonas	744
	4. Stephanodiscus	271
	5. Cryptomonas	237
	Other genera	779
	Total	3,680

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (ug/l)
04/08/74	01	0.2
	02	25.6
	03	29.2
	04	13.0
	05	21.8
06/24/74	01	0.2
	02	1.6
	03	1.3
	04	1.3
	05	3.0
10/08/74	01	4.1
	02	4.4
	03	6.5
	04	3.2
	05	7.9

E. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. 04/08/74 - Stations 01-03

Spike(mg/l)	Ortho P Conc.(mg/l)	Inorganic N Conc.(mg/l)	Maximum Yield (mg/l-dry wt.)
Control	0.005	0.663	0.1
0.05 P	0.055	0.663	1.6
0.05 P + 1.0 N	0.055	1.663	2.3
1.00 N	0.005	1.663	0.1

b. 04/08/74 - Stations 04-05

Control	0.005	0.606	1.2
0.05 P	0.055	0.606	15.4
0.05 P + 1.0 N	0.055	1.606	27.6
1.00 N	0.005	1.606	1.8

c. 10/09/74 - Stations 01-03

Control	0.005	0.290	0.3
0.05 P	0.055	0.290	1.6
0.05 P + 1.0 N	0.055	1.290	10.8
1.00 N	0.005	1.290	0.1

d. 10/08/74 - Stations 04-05

Control	0.005	0.395	0.3
0.05 P	0.055	0.395	6.7
0.05 P + 1.0 N	0.055	1.395	5.2
1.00 N	0.005	1.395	0.3

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential for primary production in Stockton Reservoir was low at the times of sampling except at Stations 04 and 05 during the spring, when it was high. Increased growth of the test alga in response to an addition of orthophosphorus indicates that the lake was limited by phosphorus during both the spring and fall. Spikes with nitrogen and orthophosphorus simultaneously generally resulted in maximum yield. Additions of nitrogen alone did not stimulate growth significantly beyond the control yields.

The N/P ratios in the lake samples were 167/1 in the spring, 54/1 in the summer, and 75/1 in the fall, further indicating phosphorus limitation.

IV. NUTRIENT LOADINGS
(See Appendix D for data)

For the determination of nutrient loadings, the Missouri National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of May and June when two samples were collected. Sampling was begun in September 1974, and was completed in August 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Missouri District Office of the USGS for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual nutrient loads, in $kg/km^2/yr$, in Turnback Creek, at Station E-1, and multiplying the means by the ZZ area in km^2.

The operators of the Ash Grove, Springfield Northwest, and Greenfield (three plants) wastewater treatment plants provided monthly effluent samples and corresponding flow data. Nutrient loads for the Ash Grove and Willard High Schools were estimated

at 0.567 kg P and 1.701 kg N/Capita/yr (180 days). Nutrient loads for the Republic, Billings, and the remaining small private wastewater treatment plants were estimated at 1.134 kg P and 3.401 kg N/Capita/yr.

A. Waste Sources:

1. Known municipal -

Name	Population Served*	Treatment*	Mean Flow ($m^3/d \times 10^3$)	Receiving Water
Ash Grove	1,100	Trickling filter	0.725	Sac River
Springfield Northwest	20,000	Activated sludge	8.732	Little Sac River
Greenfield Southwest	50	Stabilization pond	0.116	Whetzel Branch/ Sons Creek
Greenfield Northwest	150	Stabilization pond	0.107	Whetzel Branch/ Sons Creek
Greenfield Southeast	850	Stabilization pond	0.071	Wilson Branch/ Turnback Creek
Republic Lagoon B***	1,000	Stabilization pond	0.378**	Branch of Pickerel Creek/ Sac River
Springfield Municipal Airport†	300	Sand filter	0.114**	Clear Creek
Billings†	760	Stabilization pond	0.288**	Pickerel Creek/ Sac River
Lakewood Mobile Home Park†	245	Extended aeration	0.093**	Little Sac River
Springfield "44" Auto Truck Stop Inc.	294	Extended aeration	0.111**	North Dry Sac River
Willard R-2 High School	141	Stabilization pond	0.053**	Losing Stream/ Clear Creek
Chalet City	450	Extended aeration	0.170**	Branch of Pond Creek/Sac River
Sunshine Acres Nursing Home	240	Stabilization pond	0.091**	Clear Creek
Ash Grove R-4 School	103	Stabilization pond	0.039**	Sac River

2. Known industrial - See discussion, page 2.

*Treatment plant questionnaires.
**Estimated at 0.3785 m^3/capita/day.
***U.S.EPA, 1971.
†Missouri Department of Natural Resources (manuscript).

B. Annual total Phosphorus loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (nonpoint load) -		
A-2 Sac River	930	1.9
C-1 Little Sac River	3,010	6.1
E-1 Turnback Creek	6,895	13.8
b. Minor tributaries and immediate drainage (nonpoint load) -	15,390	31.0
c. Known municipal STP's -		
Ash Grove	3,015	6.1
Springfield Northwest	17,830	35.8
Greenfield Southwest	280	0.6
Greenfield Northwest	50	0.1
Greenfield Southeast	75	0.1
Republic Lagoon B	1,135	2.3
Springfield Municipal Airport	340	0.7
Billings	860	1.7
Lakewood Mobile Home Park	300	0.6
Springfield "44" Auto Truck Stop Inc.	336	0.7
Willard R-2 High School	80	0.2
Chalet City	510	1.0
Sunshine Acres Nursing Home	270	0.5
Ash Grove R-4 School	60	0.1
d. Septic tanks* -	5	<0.1
e. Known industrial - See discussion, page 8.		
f. Direct precipitation** -	1,760	3.6
Totals	49,695	100.0
2. Output - A-1 Sac River	10,740	
3. Net annual P accumulation -	38,955	

*Estimate based on 20 lakeside residences.
**Estimated (see NES Working Paper No. 175).

E. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (nonpoint load) -		
A-2 Sac River	361,080	20.2
C-1 Little Sac River	243,730	13.6
E-1 Turnback Creek	280,340	15.6
b. Minor tributaries and immediate drainage (nonpoint load) -	835,700	46.6
c. Known municipal STP's -		
Ash Grove	9,710	0.5
Springfield Northwest	38,206	2.1
Greenfield Southwest	816	<0.1
Greenfield Northwest	130	<0.1
Greenfield Southeast	225	<0.1
Republic Lagoon B	3,400	0.2
Springfield Municipal Airport	1,320	0.1
Billings	8,190	0.1
Lakewood Mobile Home Park	936	<0.1
Springfield "44" Auto Truck Stop Inc.	1,000	0.1
Willard R-2 High School	240	<0.1
Chalet City	1,630	0.1
Sunshine Acres Nursing Home	816	0.1
Ash Grove R-4 School	175	<0.1
d. Septic tanks* -	816	<0.1
e. Known industrial - See discussion, page 2.		
f. Direct precipitation** -	108,790	6.1
Totals	1,791,810	100.0

2. Output - A-1 Sac River 1,108,085

3. Net annual N accumulation - 685,125

*Estimate based on 80 lakeside residences.
**Estimated (see NES Working Paper No. 175).

D. Mean Annual Nonpoint Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Sac River	9	619
Little Sac River	6	567
Turnback Creek	13	537

E. Mean Nutrient Concentrations in Ungaged Streams:

Tributary	Mean Total P (mg/l)	Mean Total N (mg/l)
B-1 Slagle Creek	0.027	1.090
D-1 Turkey Creek	0.019	0.826
F-1 Limestone Creek	0.034	0.945
G-1 Sons Creek	0.054	1.005
H-1 Walnut Creek	0.026	0.984

Mean phosphorus values in tributary G-1, Sons Creek, are higher than those found in ungaged tributaries to Stockton Reservoir. The reason for this phosphorus inflation is not known.

F. Yearly Loadings:

In the following table, the existing phosphorus annual loading is compared to the relationship proposed by Vollenweider (1975). Essentially, his eutrophic loading is that at which the receiving waters would become eutrophic or remain eutrophic; his oligotrophic loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between eutrophic and oligotrophic.

Note that Vollenweider's model may not apply to lakes with short hydraulic retention times or in which light penetration is severely restricted by high concentrations of suspended solids in the surface waters.

	Total Yearly Phosphorus Loading ($g/m^2/yr$)
Estimated loading for Stockton Reservoir	0.49
Vollenweider's eutrophic loading	0.62
Vollenweider's oligotrophic loading	0.26

V. LITERATURE REVIEWED

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VI. APPENDICES

APPENDIX A
CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX B
TRIBUTARY FLOW DATA

[redacted]

[redacted]

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APPENDIX C

PHYSICAL AND CHEMICAL DATA

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	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

APPENDIX D

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

[illegible]

[illegible]

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FROM	OF		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TO	DAY	FEET	MG/L	MG/L	MG/L	MG/L P	MG/L -
[illegible]	15	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	14	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	14	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible]

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FROM	OF		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TO	DAY	FEET	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	09	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	14	70	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13	35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	14	75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	14	35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	09	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	09	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible]

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FROM	OF		[illegible]	TOT [illegible]	[illegible]	[illegible]	[illegible]
TO	DAY	FEET	MG/L	MG/L	MG/L	MG/L *	MG/L *
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* [illegible]
[illegible]

[illegible]

[illegible]

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FROM	OF		WHOLE	N	TOTAL	[illegible]	[illegible]
TO	DAY	FEET	MG/L	MG/L	MG/L	MG/L *	MG/L *
[illegible]	11	35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	17	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	14	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	04	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	70	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	47	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	04	44	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	04	50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	04	30	[illegible]	[illegible]	[illegible]		[illegible]

* [illegible]
LESS THAN [illegible]

[illegible]

[illegible]

DATE FROM TO	TIME DAY	DEPTH FEET	[illegible] MG/KG	[illegible] MG/KG	[illegible] MG/KG	[illegible] MG/KG	[illegible] MG/KG
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

DATE FROM TO	TIME OF DAY	DEPTH FEET	DISSOLVED NITROGEN, TOTAL MG/L	PARTICULATE NITROGEN, TOTAL MG/L	NITROGEN, TOTAL (AS N) MG/L	ORGANIC NITROGEN, DISSOLVED (AS N) MG/L	ORGANIC NITROGEN, PARTICULATE (AS N) MG/L
[illegible]	11	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	70	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	09	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	09	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13	20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12	40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10	30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FROM	OF	OF TOTAL	[illegible]	[illegible]	TOTAL	[illegible]	
TO	DAY	FEET	MG/L	MG/L	MG/L	MG/L P	MG/L P
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

A VALUE SHOWN TO BE
LESS THAN INDICATED

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37 32 [illegible] 243 36 [illegible] W
[illegible] [illegible]
[illegible]
[illegible]
SEC 40 [illegible] JUST SE OF [illegible]
[illegible]
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[illegible]

[illegible]

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FROM	TO	OF	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75/03/17	09	45	1.88	5.33	5.06	2.28	3.40	4.62	5.63
75/02/24	09	45	1.36	5.85	5.09	1.39	2.88	4.62	5.63
75/03/17	10	00	1.68	1.38	4.24	4.76	4.48	5.47	5.63
75/04/10	09	45	4.69	7.88	4.13	1.79	2.76	4.63	5.65
75/05/09			4.56	4.18	5.18	1.86	2.86	4.63	5.63
75/05/23	09	45	4.63	4.58	4.59	1.68	1.98	4.65	5.63
75/06/04	09	35	4.88	3.78	5.59	1.79	2.88	4.63	5.63
75/07/01	09	50	4.38	34.88	4.25	2.79	3.48	4.62	5.62
75/07/21	09	30	4.69	4.98	5.69	2.38	3.48	4.65	5.67
75/08/06	08	00	4.59	34.38	1.58	3.79	4.88	5.84	5.83
75/09/25	09	10	4.65	35.68	4.75	2.48	3.58	4.65	5.69
75/10/24	09	50	4.25	34.88	4.38	7.88	4.48	4.63	5.62
75/11/24	09	35	4.25	15.88	4.86	3.78	5.48	4.63	5.63

* VALUE THERE TO BE
LESS THAN INDICATED

APPENDIX E

PARAMETRIC RANKINGS OF LAKES SAMPLED BY NES IN 1974

STATE OF MISSOURI

LAKE DATA TO BE USED IN RECREATION

LAKE CODE	LAKE NAME	[illegible] TOTAL #	[illegible] INDEX #	[illegible] [illegible]	[illegible] [illegible]	[illegible] [illegible]	[illegible] [illegible] #
[illegible]	[illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] [illegible] [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PERCENT OF LAKES <IN> HIGH VALUES (NUMBER OF LAKES <IN> OTHER VALUES)

LAKE DISC	LAKE NAME	<DISCHARGE TOTAL>	<DISCHARGE INORG N>	<ORG MAT SED>	<ALK CHLORA>	<PH ANY DO>	<DISCHARGE DISS ORTHO P>
2401	CLEARWATER LAKE	100 (50)	40 (40)	50 (30)	100 (50)	100 (50)	40 (40)
2402	PRAIRIE DE TEARE RESERVOIR	20 (10)	60 (30)	40 (20)	40 (20)	20 (10)	20 (10)
2403	SIDCATON RESERVOIR	80 (40)	20 (10)	80 (40)	60 (30)	0 (0)	60 (30)
2404	LAKE TAHEYDAH	60 (30)	40 (20)	100 (50)	0 (0)	50 (20)	40 (20)
2405	THOMAS HILL RESERVOIR	0 (0)	0 (0)	0 (0)	50 (40)	50 (20)	0 (0)
2406	WARRAPELLO RESERVOIR	40 (20)	100 (50)	20 (10)	20 (10)	90 (40)	90 (40)